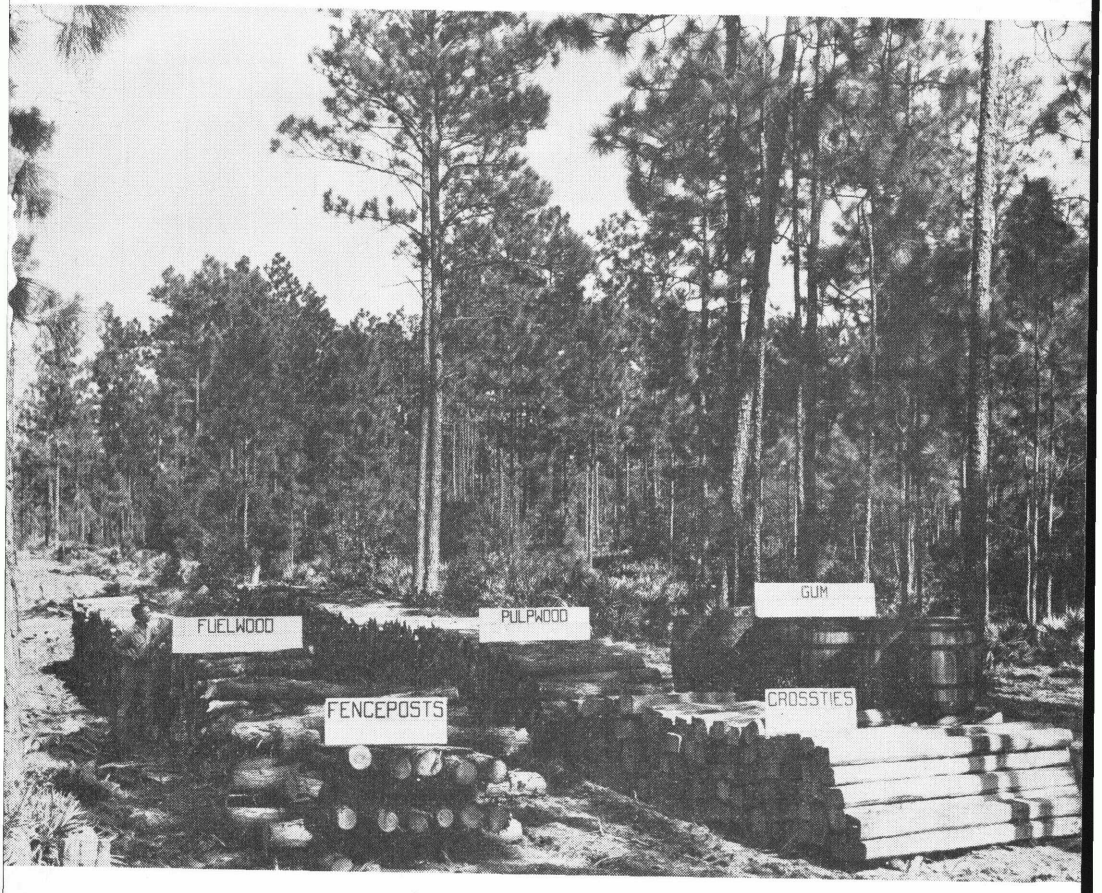
# Growing SLASH PINE

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## ACKNOWLEDGMENT

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COVER PHOTO.—Slash pine can be grown profitably as a crop. All of these products came from a 53-acre slash pine woodland in one annual harvest.

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# *Growing Slash Pine*

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## SLASH PINE—A TREE OF MANY USES

Slash pine is one of the most useful forest trees in the United States, and is planted in greater numbers than any other southern pine. Its suitability for lumber, crossties, poles, piling, pulpwood, fence posts, and gum naval stores makes it a profitable tree to grow. Because it reproduces quite readily through natural seeding, it is aggressively invading flatwoods longleaf pine stands as well as old fields and other idle or waste land. It grows about as fast as any of the other southern pines, responds better to almost every cultural treatment, and yields more gum than longleaf pine. For these reasons, farmers and other owners of small wooded tracts should have an opportunity to learn something of its management, protection, and harvesting.

The typical variety of slash pine, with which this bulletin is concerned, grows in the southeastern section of the United States from about Charleston, S. C., south and westward through the Coastal Plain of Georgia, Florida, Alabama, Mississippi, and southeastern Louisiana to the Mississippi River (fig. 1).

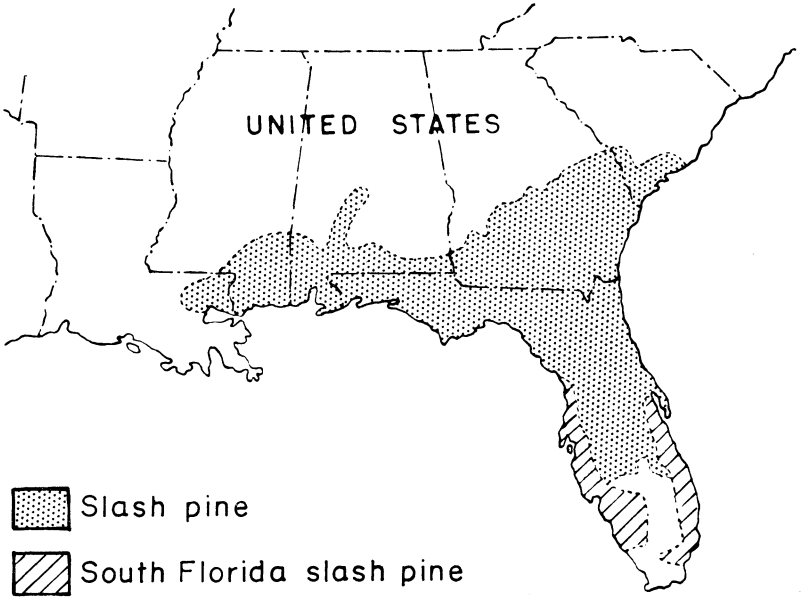


**Figure 1.—The northern and southern limits of slash pine and the area occupied by the South Florida variety.**

The slash pine found in south Florida should not be confused with the typical variety of slash pine growing farther north, although it is closely related. Its distribution is limited to the lower coastal part of Florida, as shown in figure 1. In the seedling stage the short, thickened stem and heavy needle growth give South Florida slash pine the appearance of longleaf pine. But, unlike longleaf pine, the seedlings seldom remain in the grass stage beyond the first year if protected from fire. Saplings and mature trees of South Florida pine look very much like the better known typical variety of slash pine. Its wood, however, is harder and heavier, and it does not yield enough gum (oleoresin) to pay for working it.

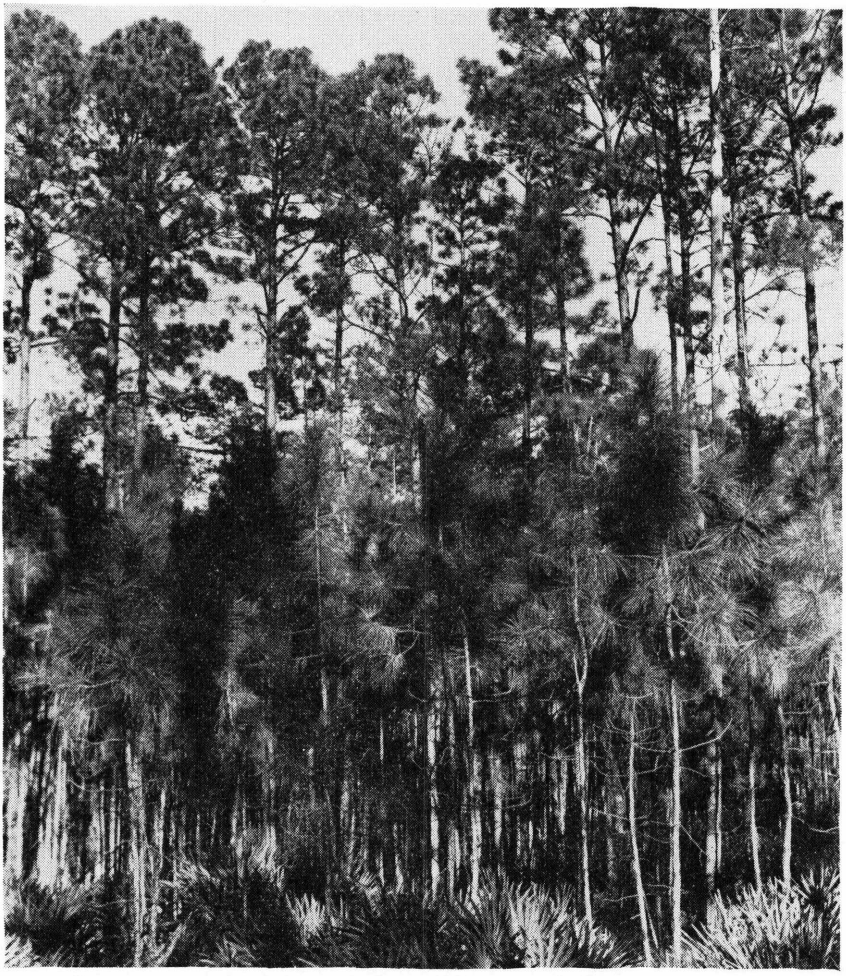

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**Figure 2.—Slash pine reproduction in a small opening at the edge of a pond. Seed trees are in the background. This species spreads out easily from groups of seed trees when protected from fire.**

The range of the typical variety of slash pine is being extended somewhat by plantings. This movement is limited in some localities, because the branches of slash pine are brittle and the extra weight of ice coatings sometimes results in considerable breakage. Several plantings in North Carolina and Virginia have shown ability to survive ice damage, but in parts of Louisiana such damage has been severe.

Slash pine was originally confined to the borders of swamps, ponds, and other poorly drained flatlands, primarily because seedlings and saplings of this species are easily destroyed by fire. More effective fire control and extensive cutting of longleaf pine stands have enabled slash pine to spread out and become one of the major species in the flatwoods of northeastern Florida and southeastern Georgia (fig. 2).

This tree makes it best growth along the margins of depressions and on better drained lowlands, but it also grows well on the better sandy loam soils of the Middle and Upper Coastal Plain. Slash pine is usually absent from the very dry, deep sands where scrub oaks prevail.

## IDENTIFYING SLASH PINE

Persons unfamiliar with southern pines sometimes have difficulty in distinguishing young slash pine from vigorous loblolly pine, and mature slash pine from longleaf pine. Correct identification is important because loblolly pine does not yield sufficient gum for commercial turpentining, and in the flatwoods of Florida and Georgia longleaf pine does not reproduce itself adequately without special seedbed preparation. Each species has distinct characteristics and can be identified by the bark, needles, winter buds, and cones.

Slash pine bark differs from that of loblolly pine by being less furrowed. It is, however, fairly similar to that of longleaf pine.

The needles grow in clusters of 2 or 3 and usually are from 8 to 12 inches long. Longleaf pine foliage is longer and coarser, while loblolly pine needles ordinarily are only 4 to 6 inches long and, in contrast to those of slash pine, occur only in bundles of 3 and have a more feathery appearance.

The winter bud of slash pine is reddish brown, and in early spring lengthens into a straight, stout, light gray "candle" about as thick as a large pencil (fig. 3).

Another characteristic that distinguishes slash pine from loblolly is its stalked cone, which is usually 4 to 6 inches long. Loblolly pine has a smaller, stemless cone. Longleaf pine has bigger cones, and thick, white buds. Mature longleaf usually has clublike twigs ending in dense tufts of needles, while slash and loblolly pine needles are better distributed along more slender twigs.

Slash pine cones, or burrs, have prickles on the end of each cone scale. Two seeds develop in hollows at the base of each scale; these hollows can be seen by examining an open burr. Mature slash pine seeds, with their small winglike appendages, are wind distributed, but usually not more than 150 to 200 feet from the parent tree. They closely resemble loblolly pine seeds in size and appearance, but the average slash pine seed is a little larger and the seed coat is usually not as thick and hard.

Mature trees of slash pine occasionally reach heights of 80 to 110 feet, with diameters at breast height from 2 to 3 feet. Such trees may be from 100 to 200 years old.

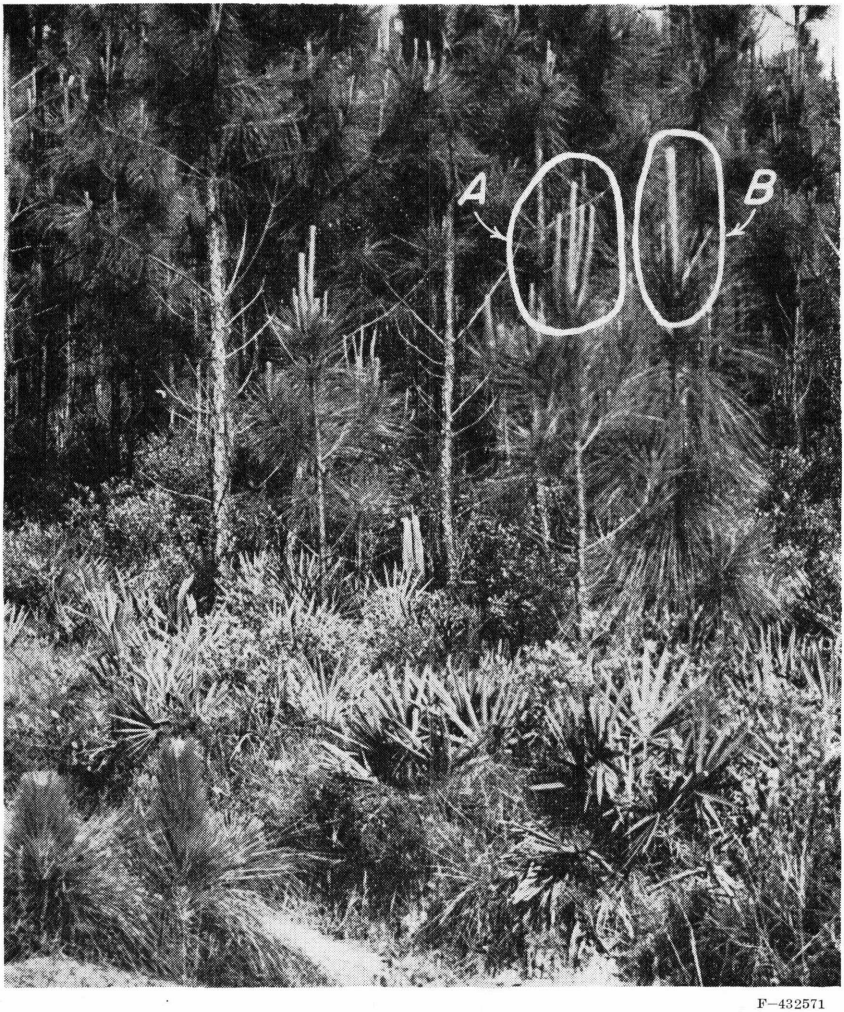


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**Figure 3.—*A*, The spring shoots of slash pine are erect, light gray, and about one-half inch in diameter. *B*, Longleaf pine "candles" are also erect but have white terminal buds about one inch in diameter. Loblolly pine shoots (not shown) are slender, grayish green, and drooping.**

## Rate of Growth

Naturally, slash pine grows faster on good soil with adequate moisture and growing space than on poor soils or where trees are too close together (fig. 4). Well-drained pure sands, hardpan soils, and lands with extremely poor drainage are less productive than the better soils. Two cords or more per acre per year are possible on the best sites if the timber is harvested at 25- to 30-year intervals. Average stands growing on relatively good forest land usually yield about 1 cord per acre per year. On hardpan or deep sand soil types, only about 0.5 cord per acre per year can be produced with good management.

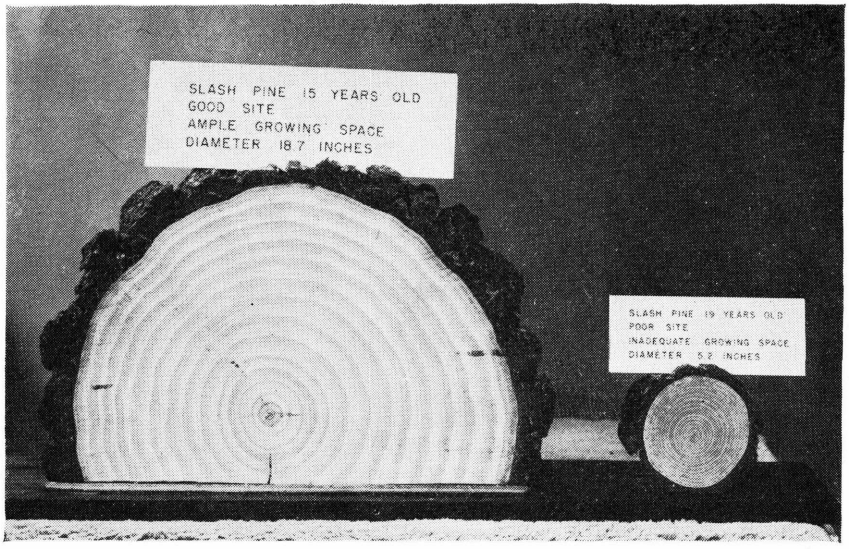


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**Figure 4.—Sections from the butts of two slash pine trees showing extremes in growth.**

Diameter growth is affected by soil productivity, age of trees, and spacing between trees. For example, the average breast-high diameter of 25-year-old slash pines planted to a spacing of 8 by 8 feet on a soil of average productivity (75-foot site) is about 7 inches. A 6- by 6-foot planting on the same site would have an average diameter of 6 inches; a 12- by 12-foot planting would have an average diameter of 8.5 inches. Slash pine stands on old fields usually outproduce those on a woods site because there is less competition from other vegetation for moisture and soil nutrients.

An average tract of unmanaged slash pine in the flatwoods of northeast Florida should produce about 320 board-feet (International ¼-inch rule) per acre per year if cut every 60 years.

## PRODUCTS

Slash pine is grown for a variety of products, including gum naval stores, saw logs, pulpwood, poles, piling, railroad crossties, fuelwood, fence posts, and veneer bolts. A farmer may not be in a position to grow or harvest all of these products, but he is able to select the ones that will yield the greatest income.

Poles and piling probably are the most valuable raw products because they utilize only the best quality timber. Production of good-quality saw logs will insure a high return; it is also probable that one, two, or more pulpwood thinnings will produce income while the saw logs are maturing. Some landowners prefer planting and clearcutting on a short rotation for continuous pulpwood production.

At times there may be no demand for either poles or piling and on occasion trees cut into crossties will bring a bigger income than a sale of saw logs. Consequently, at harvest time a woodland owner should

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consider market conditions as well as the best use for each tree. If the market for timber products is poor, he can obtain an income from turpentining while waiting for better stumpage prices.

Gum production can be a good supplemental source of income, especially in the years between cuts when there is no cash return from wood products. Nearly 20 percent of the total dollar yield of the forest may be provided by conservatively turpentining the larger trees. On the farm woodland, however, a gum farmer often realizes up to 35 percent of his total dollar yield through a naval stores operation.

## HOW TO ESTABLISH A STAND

Slash pines produce good cone crops fairly often, the seeds germinate readily, and the young seedlings grow rapidly. So, there should be little difficulty in growing one crop after another on the same land. The necessary requirements for establishing a young stand are protection against fire and an adequate supply of seed on open ground. If there are no seed trees, then the land can be planted, but fire should be excluded for 5 to 10 years and closely controlled thereafter.

### NATURAL REPRODUCTION

Where a stand of timber is already on the land, openings made by logging should fill in with new seedlings (fig. 5). Slash pine may start producing seed on open-grown trees when only 10 to 15 years old, and at 30 to 40 years of age most trees can be counted on for some seed almost every year, with fair to good production every 2 or 3 years. Cones may begin to open toward the end of September, with most of the seedfall occurring in October. If there is enough moisture in the soil, the seeds germinate within 2 weeks after they fall.

As far as possible, logging should be done in a manner that will leave an even-aged stand rather than an all-aged stand. This will aid prescribed burning and turpentining in later years. Prescribed burning is not feasible in an all-aged stand where some new seedlings start every year, because slash pine seedlings under 12 feet in height are easily damaged by fire. If the timber to be logged occurs in even-aged patches, then selection of the older groups for cutting may be suitable.

A form of even-aged management adaptable to most conditions is to leave 25 to 40 of the better trees reasonably well distributed on each acre at the time of harvest. This number will support a profitable turpentine operation and at the same time seed in a new stand promptly. If stumpage values are high, and the owner does not wish to produce naval stores, the original stand may be cut back to 4 or 5 seed trees per acre.

The seed trees should be the very best available, free of disease and insects, with straight trunks, well-formed crowns, a good rate of growth, and evidence of good seed-producing ability. The prospects for future seed production can be estimated from the abundance of new cones in the treetop or old cones on the ground. Careful selection of an adequate number of seed trees will give a landowner the best possible chance for a future forest of good quality at very little extra cost.

If too few seed trees or relatively poor seed producers are left, planting usually will be required (fig. 6). An exception may occur if

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**Figure 5.—Slash pine reproduction in small openings within the stand.**

logging is done in September in a good seed year so that the mature seeds from the entire stand fall on freshly disturbed earth. Under the best conditions, these seeds may germinate in sufficient numbers in a few weeks. But if the seed crop is poor, or rodents and birds eat the seeds, planting is the only means of obtaining a new forest.

## PLANTING

Slash pine seedlings are hardy, and if properly planted the chances of their living are very good. They can be purchased at reasonable cost from State-operated nurseries. Any State forester, farm forester,

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**Figure 6.—This clear-cut area without adequate seed trees must be planted in order to obtain another crop.**

extension forester, or county agent can assist in the purchase of seedlings and provide instructions on when, where, and how to plant them. Some pulpwood companies provide free seedlings in limited quantities to landowners and plant millions of seedlings on their own lands. Anyone desiring seedlings from either public or private nurseries should put in an order as soon after July 1 as possible. Orders are scheduled for shipment as received and rarely are there enough seedlings to supply the demand.

When you order seedlings, ask for advice on how to plant them. There are many publications that explain in detail nearly every phase of reforestation. A list of some of these is given on page 28.

Planting in December or January usually results in better survival than later planting. Where spring droughts are common, plant as early as seedlings can be obtained. This may permit them to become better established before the critical period. On the other hand, fall droughts also can be detrimental, so planting should not begin until the soil has been soaked by rain.

If the seedlings cannot be planted within a day or two after you get them, they can usually be kept safely for several weeks by heeling them into light sandy soil in a shady place. Dig a trench 2 to 4 inches deeper than the seedling roots are long, and with one side smooth and slightly sloping. If there are more than 100 seedlings per bundle, open the bundles and pack the plants against the sloping side of the trench in a layer about 3 inches thick. Be sure the roots are unbent and that the tops stick up above the soil. If there are 100 or less seedlings per bundle, the unopened bundles can be packed closely together, in a layer only 1 bundle thick, along the side of the trench. Cover the seedlings roots or bundles with firmly packed earth, and water the bed often enough to keep the soil continuously moist but not saturated.

A planting bar, or dibble (fig. 7), will make hand planting easier, although an ordinary shovel can be used if necessary. Remember these main points:

(1) In the field, the seedings should be kept moist, rather than wet, and in a sheltered spot until they are planted. Puddling is unnecessary and the roots should not be placed in water.

(2) Dig the hole deep enough to accommodate the roots without doubling them up or tangling them; doubling up or tangling may lead to strangulation, decay, and windfall in the sapling or pole stage.

(3) Plant the seedling at the same depth at which it grew in the nursery or slightly deeper, with the slit fully closed at the top.

(4) Pack mineral soil firmly about the feeding rootlets so that they can absorb moisture.

(5) Protect the young seedlings from fire, goats, hogs, and heavy concentrations of cattle.

The owner's objectives will play a large part in the choice of spacing. The narrower spacings—8 by 8 feet—favor maximum cubic-volume growth per acre, and the wider spacings—12 by 12—favor earlier production of merchantable-size trees. At a spacing of 8 by 8 feet, and under favorable conditions, about 600 or 800 seedlings can be planted by 1 man in a day. This spacing will provide 681 seedlings per acre. Many people now prefer to leave about 12 feet between the rows to permit the use of trucks and other equipment, and to reduce the cost where the trees are planted by machine. By this scheme, the spacing within the rows will be less than 12 feet if 600 to 800 seedlings per acre are desired.

Reforestation of abandoned fields or other open areas can be accomplished more readily with a planting machine (fig. 8) if the equipment is available. In some States, planting machines can be obtained for a few days from local banks or soil conservation districts at a small charge. Larger plantings can be contracted for with private companies at rates that may vary from 1 to 1½ cents per planted seedling.

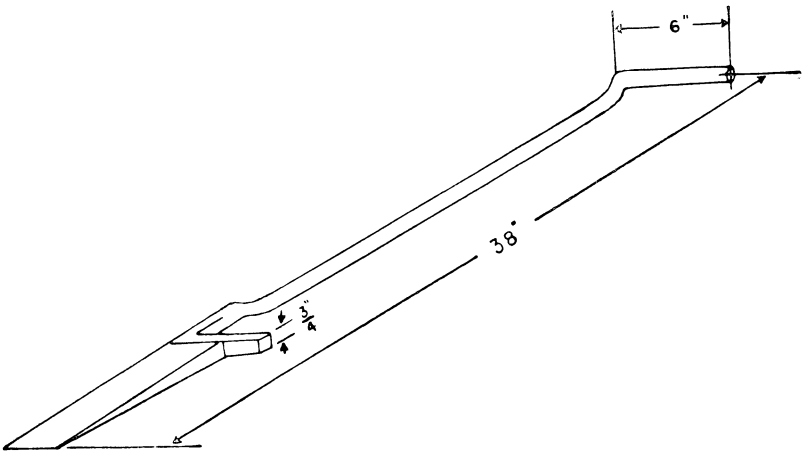


**Figure 7.—A planting bar can be bought from various tool companies or made by a blacksmith.**

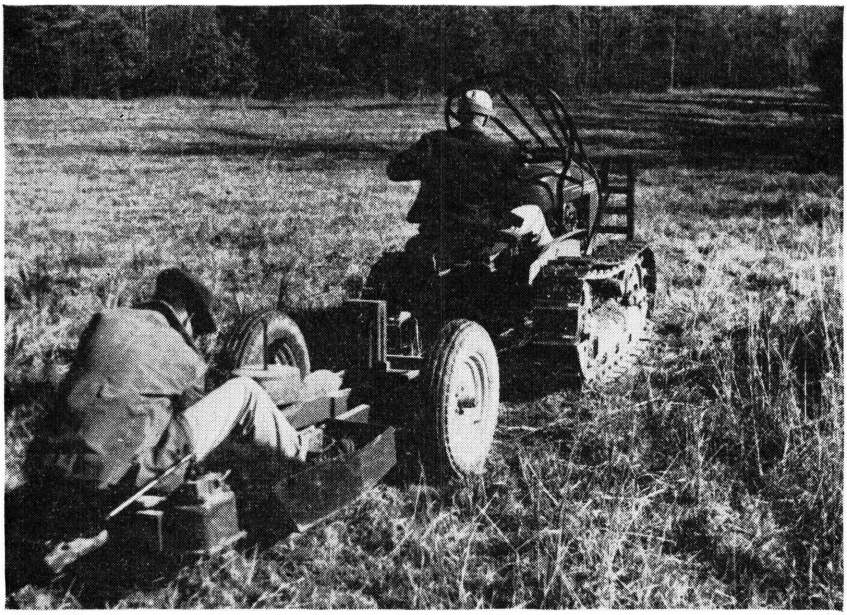

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**Figure 8.—With a planting machine, two men can plant about 1,000 seedlings per hour on open land.**

The landowner must obtain the seedlings. Figure 9 shows the progress of one farmer's planting program.

Some industrial companies are using planting machines successfully on recently cutover land, although they cannot achieve a regular spacing because of stumps and other obstructions. Interference from logging debris is reduced by attaching a heavy-duty, double-moldboard plow between the tractor and the planting machine or running a heavy brush chopper over the area. Usually, such tracts are clear cut at least a year in advance of planting, because seedlings planted on freshly logged areas frequently are attacked by pales weevils.

## Direct Seeding

Sowing seed instead of planting seedlings is occasionally successful, but this method is not recommended as a practical way of reforesting slash pine. Usually the results are not satisfactory, because birds and rodents consume large quantities of the seed, and many young seedlings die during excessively hot, dry periods.

## Prescribed Burning

Protection against fire is essential for the greatest production of timber, but complete exclusion of fire causes heavy litter to accumulate in the woods. In such fuel, wildfires burn intensely and spread rapidly, making control difficult. As a result, all seedlings and many young and mature trees are killed; some trees are not killed outright, but they are weakened so that they may be attacked by insects. This hazard can be reduced by prescribed burning.


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**Figure 9.—For 9 years this farmer hoped that pines would "take over" this worn-out and idle hillside near his home in central Mississippi. Then he planted slash pine seedlings, 8 by 8 feet apart, or 681 to the acre. *A*, Trees, 1 year after planting. *B*, Same stand 10 years after planting; age of trees, 12 years from seed. The farmer has cut and used fuelwood and sold pulpwood in thinning out the poorer trees.**

Prescribed fire is a land manager's tool—a prescription to be used only in the right times and places. It is primarily for protection, but it also keeps undesirable hardwoods and brush under control and prepares seedbeds for natural reseeding. Prescribed burning for seedbed preparation is most effective when it immediately precedes a good seed fall. Also, it should be done before the harvest cutting, because fires in logging slash injure and kill the seed trees, burn cones on the felled tops, destroy seed on the ground, and are very difficult to handle.

When slash pines get to be about 12 feet tall, they can withstand a moderate backfire (burning against the wind), but many precautions must be observed for successful burning. The outside edges of the proposed burn should be adequately surrounded by natural barriers such as roads, fields, wet swamps, or water, or with plowed firelines. Inside patches of valuable young trees too small to withstand prescribed fire should be protected by plowing furrows around them. If more than 10 acres are to be fired at one time, firelines should be plowed at about every ⅛ mile crosswise to the direction in which the backfire will burn (fig. 10).

If the wind is from the north, the lines should be plowed east and west, setting the backfire on the north side of the line and letting it back into the north wind. Backfires should be set only when the right burning conditions exist; that is, during cool weather in late fall or winter, with a 3- to 10-mile-per-hour steady wind, generally from the north and usually 1 or 2 days after a rain. Under such conditions the possi-

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**Figure 10.—With good firelines and proper burning conditions, prescribed burns in a light fuel result in little damage.**

bility of damage to tender buds, needles, and twigs is lessened, the fire is easier to control, sudden changes in weather are less likely to occur, and the fuel should be dry enough to carry the fire on a uniform front.

When to burn is a very important decision. Burning should not be attempted unless there is uniform wind of steady direction, and proper fuel moisture. Understimating either of these conditions can change success to failure. Burning on a warm day may cause excessive damage even though other conditions are favorable. On such days twigs that are already warm may be heated to a killing temperature by a ground fire.

Prescribed burning should not be attempted in any stand that is being turpentined unless all flammable material has been raked away from each faced tree. It is good practice to prescribe burn a stand before the first cupping.

Fire can be helpful in the management of slash pine timber, but use it carefully—**it is a dangerous tool.** The responsibility of conducting prescribed burning rests with the property owner; however, he should ask a forester or some other qualified person for advice and assistance. In counties that have organized fire protection, the ranger can usually be called upon for help; forest industries also have competent men who can often be called on for assistance. The landowner should be prepared to confine the fire to the area he plans to burn and comply with the law regarding burning.

## PROTECTION

Rodents, birds, livestock, fire, insects, and diseases all attack slash pines during some part of the life cycle from seed to sawtimber.

### RODENTS AND BIRDS

Loss or injury by rodents and birds is confined to cones, seeds, or very young seedlings. Sometimes squirrels will cut many unripened cones from the twigs. Birds and mice consume large quantities of seed and play an important role in any failure to obtain reproduction during a light seed crop. Birds also may damage very young seedlings, and cotton rats have been known to girdle the tender bark of larger seedlings. The average owner cannot control these losses, but he can lessen their effect by leaving enough seed trees to provide an ample supply of seed.

### LIVESTOCK

Cattle usually do little damage to slash pine unless concentrated in an area where they may trample young seedlings. Hogs may root up a few seedlings but generally are not considered to be a major problem in the flatwoods forests of Florida and Georgia. Elsewhere it might be necessary to fence hogs out of seedling stands for a year or two. Concentrations of goats may, of course, result in severe damage to seedlings.

## INSECTS

Throughout its life cycle, slash pine is subject to attack by various insects. The most common ones found on young seedlings are tip moths, pales weevil, webworm, and sawfly. As the tree becomes larger, the first three of these insects are less injurious. Sawflies, however, can be injurious to slash pine almost throughout its entire existence, though seedlings, saplings, and pole-size trees usually are preferred.

Tip moths kill the bud and part of the shoot immediately below the bud. The damage is done by small wormlike, pale-brown to pale-pink larvae that bore inside the bud and down the center of the twig. Seedlings less than 10 to 12 feet in height often suffer loss of current leader growth and may become deformed as a result of tip moth injury. Death of the seedling seldom occurs as a result of attack by this insect.

Damage by the pales weevil may be very serious, particularly to young seedlings planted in an area immediately after the cutting of pine or adjacent to a pine stand severely damaged by fire. Pales weevil feeds on the bark at the base of the seedling though it may move on up into the needles. One- to 3-year-old seedlings may be markedly reduced in growth and vigor or killed as a result of partial or complete girdling. There are other beetles which may also feed on the bark in a somewhat similar manner. If pales weevils are numerous, planting should be delayed at least one year after logging.

The pine webworm commonly feeds on 1- to 3-year-old seedlings in both natural and planted stands. It is easily recognized by the mass of loose brown frass that is held together by silk or webbing. Dull-brown, longitudinally striped caterpillars can be found in silken tubes within this web. Though there may be as many as 20 caterpillars in 1 web, 3 to 8 is the usual number. These larvae feed on the needles, usually working from the terminal bud downward. Complete stripping of the needles often kills small seedlings. Although webworm may be found on larger trees, its feeding is not so injurious to them. Control on forest areas is not practical. Infestations in plantations or on ornamental trees, however, can be controlled by thoroughly spraying the seedlings with 1-percent water suspension or emulsion of DDT, or by hand-picking the nests.

Sawflies feed on the needles of slash pine, especially in the earlier years. The larvae, which do the feeding, are typical hairless caterpillars that are usually striped or spotted. When full grown, they are about 1 inch long. They usually feed in groups of 10 to 40 and will rear back suddenly and remain motionless when disturbed. Sawflies prefer to feed on the older needles. However, when they have eaten these, they will move on to the new needles and may completely strip the tree. Death of the trees rarely occurs, but young seedlings will die as a result of severe attack. Larvae may be controlled by spraying a 1-percent water suspension or emulsion of DDT on the infested trees.

The bark beetle is the most destructive insect that feeds on slash pine above pole size. The three main species are *Ips*, black turpentine beetle, and southern pine beetle. Though all three have distinctive habits, all are similar in some respects. Attacks are made through the bark of living trees, usually causing pitch tubes to be formed on the outside of the bark (fig. 11). Tunnels or galleries are made in the soft

inner bark and never enter the wood. Eggs are laid in the soft bark and the small grublike, white-colored larvae start feeding in the same area. As a result of their activity the tree usually will die.

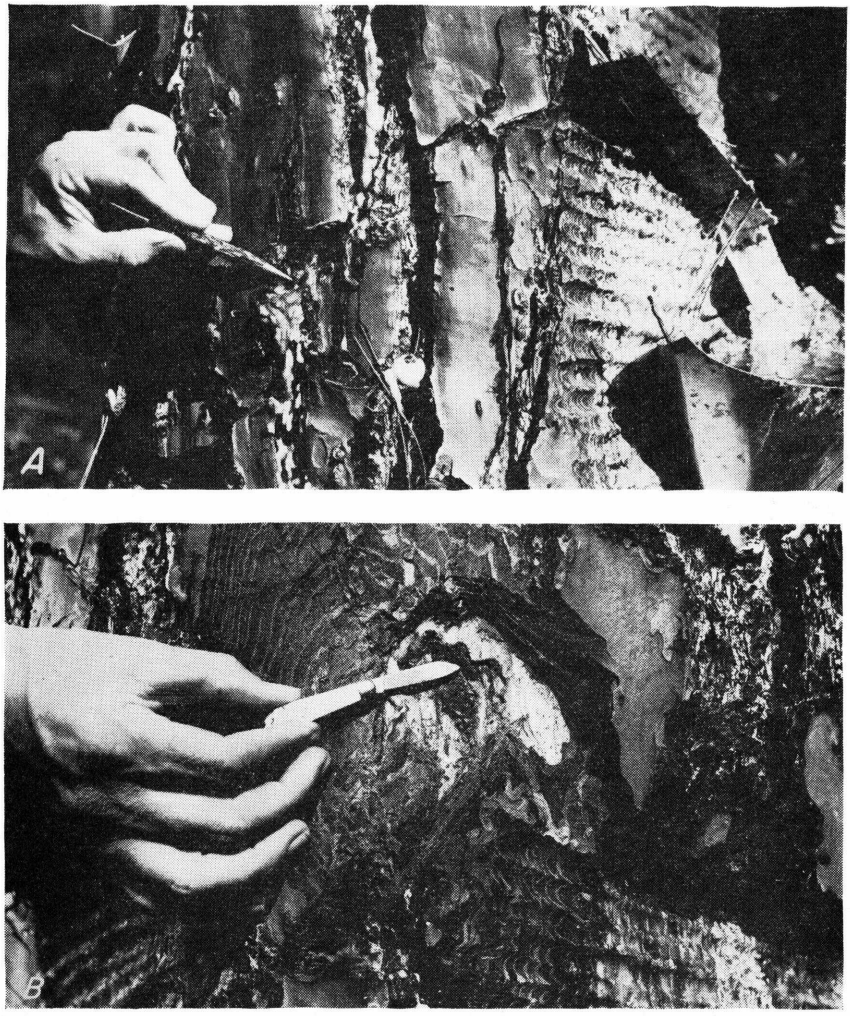


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**Figure 11.—*A*, Pitch tube, and *B*, damage to inner bark caused by black turpentine beetle.**

In general, bark beetles attack trees weakened or scarred by lightning, fire, turpentining, or logging. When conditions are right, as during periods of drought, the bettles may multiply greatly and attack nearby healthy trees. If large groups of trees are infested, the State Forester should be consulted immediately.

Detailed information on the habits and control of forest insects can be obtained by writing to the Southeastern or Southern Forest Experiment Stations at Asheville, N. C., and New Orleans, La., respectively.

## DISEASES

Vigorous young slash pines are not usually seriously affected by fungus diseases that sometimes attack their needles, stems, and roots. However, after the tree is 80 years or older, red heart may weaken it and destroy the value of the affected wood. The best protection is to cut the trees before they are overmature.

A fusiform rust disease often attacks the stems and branches of slash pine and causes cankers that deform and weaken the tree. Only stem cankers will kill trees, and those that encircle more than half the stem are likely to cause death within 5 to 8 years. Branch cankers should be removed if they are within 15 inches of the stem.

Slash pine trees infected with stem canker (fig. 12) should be cut in a thinning or improvement operation. It is not necessary to cut all

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**Figure 12.—Fusiform rust caused the canker on the lower part of the trunk and the swelling on the large branch of this young slash pine.**

of them if cutting would make very poor spacing. However, all should be cut which are so weakened by the disease that breakage is likely. Experience has shown that slash pine planted outside its natural range is more susceptible to fusiform rust.

Young slash pine is occasionally attacked by the pitch canker disease that kills leaders, branches, and trunks of small trees. This disease is usually found in the upper part of the tree and is recognized by a profuse flow of gum. Although distributed widely, it seldom destroys many trees.

Needle disease on slash pine often causes considerable concern that large numbers of trees may be dying. This is particularly true of *Hypoderma* blight that causes a striking late-winter browning, and less so of the brown spot disease and needle rusts. Trees usually recover rapidly from these attacks, with little noticeable loss in growth.

## HOW TO MANAGE THE STAND

Slash pine trees on moist soils and with ample room in which to grow are usually much larger than trees of the same age in dense stands. Young stands often start as dense thickets following a good seed crop. Such stands are too dense for good growth. Also, as trees become older they have a natural tendency to slow down in growth. Therefore, at all ages, it is desirable to encourage optimum growth by maintaining the proper spacing between trees. Fortunately, slash pines respond readily to good management.

### THINNING

If 600 to 800 well-spaced seedlings become established on each acre, little additional attention other than fire protection is needed until the trees reach pulpwood size.

In denser stands, natural thinning occurs as the more vigorous trees overtop and crowd out their neighbors. This often is a very slow process. The cutting of all excessively limby, poorly formed, and diseased trees, as well as those unlikely to attain merchantable size in a reasonable time, will favor growth of the better trees.

Dense thickets with thousands of young saplings on each acre should be thinned to a spacing of approximately 8 feet between trees. This should be done before the trees have an average diameter at breast height of 2½ inches, because thinning of larger sizes as a stand-improvement measure is too expensive. Also, trees that have already reached 4 inches in diameter can soon be sold as pulpwood.

Thinning for stand improvement will be profitable if out-of-pocket labor costs are not too high. The time spent on this work will vary from 2 to 8 man-hours per acre according to the size and density of the stand. Such treatment was applied to a young sapling stand on the Olustee Experimental Forest in 1944. In 1954, 10 years later, the thinned stand contained 18 merchantable cords per acre, while the adjoining unthinned tract had only 7 cords per acre. The size and distribution of the trees in the 18-cord stand made logging easy, and the buyer offered $4 per cord. But in the 7-cord stand the merchantable trees were scattered about in a dense stand of under-size

stems. This made logging difficult and reduced the stumpage value to less than $2 a cord.

Stand-improvement thinning can also be done in young seedling stands with simple farm equipment, such as a disk harrow. Heavier equipment, such as a crawler tractor and a heavy-duty brush cutter, may be necessary in dense stands of small saplings. Parallel strips 6 to 8 feet wide should be cut through the dense stand, leaving intervening uncut strips 2 feet or more wide. The area can also be crisscrossed, thus leaving small clumps of trees. While this method is cheaper than hand thinning, it is not selective and must be done when the reproduction is still quite young.

Commercial thinnings produce income as the stand develops, and also provide for larger, better quality trees for later use. The exact number of trees to remove will depend on the stocking, plans for future naval stores utilization, owner objective, and the number of thinnings planned before the final harvest. Diseased, deformed, or injured trees, and those too close for good growth should be cut in each thinning. Later thinnings should be similar to those in the first commercial cutting, except that the trees to be removed may be turpentined before logging if they are large enough.

Most foresters recommend that slash pine stands be thinned at intervals of 5 to 10 years in order to provide the correct spacing for good growth and to salvage any trees damaged by fire, lightning, insects, or disease since the last improvement cut. Growing-space requirements increase as the trees grow larger; the recommended spacing for each size is given in table 1.

The first thinning in many stands may also be an improvement or salvage cut and often is the first step in converting an untended woodland to a managed forest. All diseased, deformed, dying or otherwise undesirable trees are removed as in any other thinning. Your local forester will have helpful advice on when and how to thin.

## PRUNING

In well-stocked slash pine stands the lower branches gradually die as they become shaded from the sunlight. Even though such natural pruning is often slow, the trees make good quality saw logs, poles, and piling. Hand pruning occasionally is profitable in these stands. In medium-stocked stands, however, the trees definitely require artificial pruning if they are to yield timber of good quality (fig. 13). Pruning should only be done when sawtimber is the objective. It is usually poor business to invest any money in pruning broad-crowned, short-stemmed trees that have many limbs.

Pruning of the first 16-foot log should be completed as soon as the tree is large enough to withstand the removal of the side branches. This can be done in one or two operations, provided a living crown is left on the upper one-third of each tree. A practical schedule for pruning slash pine was developed at the Southeastern Forest Experiment Station:

(1) When heights average 15 to 18 feet, prune to 8 feet.
(2) Five to six years later, when heights average 33 to 36 feet, prune to 17 feet.

TABLE 1.—*Recommendations for thinning young slash pine*

| Approximate size of average dominant and codominant trees,[1] wolf trees excluded | | Recommendation | Approximate stand to leave if thinning is made | |
|---|---|---|---|---|
| Diameter breast high (inches) | Total height (feet) | | Trees per acre | Average spacing |
| | | | *Number* | *Feet* |
| Under 2½ | Under 15 | Thin only if (a) more than about 5,000 trees per acre and heights are very uniform, or (b) crown-length ratios[2] of dominant and codominant trees are under 40 percent. | 600–800 | 7½– 8½ |
| 2½–4 | 15–30 | Thin only if (a) more than about 1,500 trees per acre and heights are very uniform, or (b) crown-length ratios of dominant and codominant trees are under 40 percent. | 400–800 | 7½–10½ |
| 4½–5½ | 30–40 | Thin only if (a) commercial or usable volume can be removed while leaving at least 45 square feet of basal area per acre in good dominant and codominant trees, or (b) crown-length ratios of dominant and codominant trees are under 33 percent. | 300–600 | 8½–12 |
| 6 –8 | 40–50 | Thin as soon as commercial or usable volume can be removed while leaving stand specified at right. | 200–400 | 10½–15 |

[1] *Dominant.* Trees with crown extending above the general level of the crown cover and receiving full light from above and partly from the side; larger than the average trees in the stand, and with crowns well-developed but possibly somewhat crowded on the sides. *Codominant.* Trees with crowns forming the general level of the crown cover and receiving full light from above, but comparatively little from the sides; usually with medium-sized crowns more or less crowded on the sides.

[2] *Crown-length ratio.* The percent of the total height in live crown.

Source: *Recommendations for Thinning Young Slash Pine,* by Henry Bull. Forest Farmer 8 (6): 9. 1949.

Because this schedule permits earlier work, it results in more clear material, a smaller knotty core, and smaller branch wounds that heal over sooner. Only those trees from which the final selection of large crop trees is likely to be made, usually not more than 150 per acre, should be pruned.

## HARVEST CUTTING

Slash pine timber can be harvested in the form of poles, piling, saw logs, crossties, pulpwood, fuelwood, or fence posts. The owner must decide which of these he will produce, and he should base his judgment


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**Figure 13.—*A*, This tree was freed of limbs on the lower part of its stem at an early age and will produce the kind of knot-free lumber the man is holding. *B*, Limby trees produce knotty lumber.**

on market conditions and the quality of his timber. The highest return usually will be obtained by marketing a variety of products—selling each tree at its greatest value.

When to harvest will depend primarily on what the owner has decided to produce. Slash pine grown for pulpwood can be harvested at 20 to 30 years of age; if grown for medium-sized products, it can be harvested at about 35 to 50 years of age; and if grown for large products, a harvest age of 50 to 65 is best. The lower figures apply to trees on better than average soils, and the highest ones to trees on below average soils. Plantations of slash pine on very good sites, and with wide spacings, occasionally produce pulpwood in 15 years and small saw logs in 25 years.

At the time of final harvest, provision must be made for a new crop, either in the form of seed trees left to restock the land, or by planting the area. If a heavy rough of pine needles or understory vegetation is present, prescribed burning or disking or otherwise disturbing the forest floor before cutting may be necessary to prepare a favorable seedbed. In years when the seed is plentiful, 4 or 5 large cone-bearing trees per acre should be enough to establish an acceptable stand of seedlings. More trees will be needed in years of less abundant seed.

Some landowners prefer to leave 25 to 40 mature trees per acre in the form of a shelterwood to insure prompt seedling establishment and to produce some income while they are waiting for the next cut. Twenty-five or more large slash pines per acre will support a turpentining operation and also provide a good saw-log sale after the land becomes reseeded.

If possible, harvest cutting should be done either immediately before or in a good seed year. When the seed trees are small, poorly distributed, and unfruitful. or if the stand is logged during a cycle of poor seed years, planting may become necessary. It is not advisable to wait more than a very few years for a natural stand to establish itself, because the value of lost growth will more than offset the cost of planting.

## GROWTH AND YIELD

An estimate of potential yield for heavily stocked, unmanaged, natural stands on an average flatwoods site is given in table 2. This is not a precise estimate, because fire injury can reduce height growth by as much as 20 feet by the time the stand reaches 50 years of age. However, this table can be used as a general guide.

On sites about average for the flatwoods, the yield table shows that average annual production in cords is highest at an early age and falls off gradually in stands over 20 years old. A 35-year rotation on an average site with an adequate distribution of age classes will yield approximately 1-⅓ cords per acre per year. On a 60-year rotation a similar site would yield about 320 board-feet per acre per year.

Yield figures for managed stands that have had several thinnings to provide optimum growing space are not yet ready. However, it is safe to say that in comparison with table 2, managed stands will have fewer trees per acre, larger average tree diameters, and earlier and higher yields of sawtimber. Yields in a managed forest will also be increased by the amount removed in cuttings for medium-sized products.

TABLE 2.—*Average number, size, and volume per acre of dominant and codominant slash pines at various ages in fully stocked unmanaged stands on average sites*

| Age of trees (years) | Average height | Average diameter at breast height | Trees | Merchantable volume [1] | |
|---|---|---|---|---|---|
| | | | | Pulpwood | Sawlogs |
| | *Feet* | *Inches* | *Number* | *Rough cords* | *Board-feet* |
| 15 | 34 | 4. 6 | 780 | 21 | 634 |
| 20 | 42 | 5. 2 | 640 | 28 | 1, 810 |
| 25 | 49 | 6. 3 | 510 | 34 | 4, 073 |
| 30 | 56 | 7. 3 | 400 | 40 | 6, 788 |
| 35 | 61 | 8. 1 | 315 | 46 | 9, 955 |
| 40 | 64 | 8. 9 | 265 | 49 | 12, 670 |
| 45 | 67 | 9. 5 | 235 | 53 | 14, 480 |
| 50 | 70 | 10. 0 | 220 | 55 | 16, 290 |
| 55 | 72 | 10. 4 | 205 | 57 | 17, 648 |
| 60 | 74 | 10. 8 | 195 | 59 | 19, 005 |

[1] Utilization assumed to a fixed top diameter of 3 inches for pulpwood (stacked cords including bark) and at 5 inches for sawlogs (International log rule with ¼-inch kerf). Pulpwood volume also includes volume shown in column headed "sawlogs."

Source: Tables 129, 142, 155, 156, 157, and 159 of *Volume, Yield, and Stand Tables for Second-Growth Southern Pines.* U. S. Dept. Agr. Misc. Pub. 50, 202 pp. 1929.

On the demonstration farm woodland of the Olustee Experimental Forest, where saw logs, pulpwood, gum, fence posts, and other medium-sized products are being produced, it is estimated that a growing stock of approximately 20 cords per acre will be needed in order to obtain the greatest possible yield each year. This woodland had 12 cords per acre when placed under management in 1944, which is slightly above the estimated 9 cords on the average acre in southeast Georgia and twice as much as the 6 cords in northeast Florida.

The initial stand of 12 cords per acre on the Olustee was reduced somewhat by removal of all worked-out turpentine trees and others that were diseased, deformed, or growing in crowded clumps. This improvement cutting placed the forest in better condition and, during the 10 years of management, net annual growth increased from less than half a cord to more than one cord per acre per year. Only part of the growth is harvested each year while the stocking is being built up to the desired stocking of 20 cords or more per acre. When that level is reached, the annual yield will be increased considerably.

## COST AND RETURNS

An ordinary farm woodland can be operated without much cash expense. Seedlings can be bought at reasonable cost from State nurseries and sometimes are available free of charge from other sources. Small openings can be planted by hand. Cultural treat-

ments, such as thinning or pruning young stands, and cutting out cull trees, can be done at odd times. Taxes of course must be paid each year, firelines must be renewed annually, and every 5 or 6 years prescribed burning may be desirable as a protection against wildfire.

Management of larger forests will be more expensive, because extra help must be hired for most jobs. Planting may cost from $7 to $15 per acre in addition to the cost of the seedlings. Thinning for stand improvement may vary from $2 to $10 per acre, and marking of trees for a timber sale must be paid for. Other expenses, such as taxes, fire protection, road or fence maintenance, and general administration, may be from 50 to 75 cents per acre annually.

Cash returns from the forest will vary with market conditions and the manner in which the products are sold. The choices are as follows:

(1) Sell trees standing, as stumpage, or by the face for naval stores operations. Naval stores can also be sold by specifying a certain percent (about 20 to 25 percent) of the price received for crude gum at the still.

(2) Fell the trees, cut them into logs, poles, pulpwood, or other products and sell at the stump.

(3) Cut the products and sell them delivered to the road, railroad siding, or mill.

The greatest return is obtained when the landowner does his own logging, but this may not always be possible. Sometimes special equipment is needed, and without adequate experience a logging operation may not be practical or safe. In these instances, or when the owner cannot do the work himself, selling on the stump is the best procedure. The landowner who plans to do his own logging should ask for the local forester's advice on safe cutting and logging methods.

A typical farm woodland on the Olustee Experimental Forest gave an average annual cash return from 1944 to 1954 of $2.72 per acre for stumpage plus $6.82 for the labor used in harvesting the products, or a total income of $9.54 per acre every year for 10 years. Even larger annual incomes will be possible as the condition of the woodland improves.

## ESTIMATING VOLUME

The timber owner should make an estimate of the quantity and value of the timber he sells. Ofttimes the State forestry department will help in the estimating and can furnish advice on marketing, or the services of a private consulting forester can be obtained for a reasonable fee.

The board-foot volume of merchantable wood for slash pine trees is shown in table 3. Table 4 shows the number of trees per cord. Appropriate board-foot volumes are calculated according to the International ¼-inch rule, to an 8-inch diameter outside bark when merchantable. Average cordwood volumes represent the merchantable stem to a 4-inch top.

Sometimes the part of the tree trunk above the last saw log, called "topwood," can be used for pulpwood. The cubic-foot volume of

merchantable pulpwood left in the tops of slash pine sawtimber, harvested to an 8-inch top, is as follows:

| *Diameter of sawtimber, breast high (inches)* [1] | *Average topwood volume for 1,000 board-feet of sawtimber (cubic feet)* [2] |
|---|---|
| 10 | 231 |
| 12 | 67 |
| 14 | 30 |
| 16 | 16 |
| 18 | 10 |

[1] If logs smaller than 8 inches in diameter are used for lumber, this estimate of topwood volume is not applicable.
[2] Ordinarily 90 cubic feet of wood and bark approximate 1 stacked cord.

The following rule of thumb can be used in making quick estimates of cords and board-foot volumes:

| *Tree diameter (inches)* | *Trees per cord* [1] *(number)* | *Trees per thousand board-feet* [2] *(number)* |
|---|---|---|
| 6 | 24 | -- |
| 7 | 15 | -- |
| 8 | 10 | -- |
| 9 | 7 | -- |
| 10 | 6 | 20 |
| 11 | 5 | 14 |
| 12 | 4 | 10 |
| 13 | -- | 8 |
| 14 | -- | 7 |
| 15 | -- | 6 |
| 16 | -- | 5 |
| 17 | -- | 4 |
| 18 | -- | 3 |

[1] To convert stacked cords (4 by 8 by 4 feet) to units (4 by 8 by 5.25 feet), multiply by 0.762. There are approximately 3 units to every 4 cords.
[2] International ¼-inch rule.

TABLE 3.—*Average board-foot volume in slash pine trees of different lengths, International ¼-inch rule, rounded to the nearest 5 feet* [1]

| Diameter breast high (inches) | Volume when number of usable 16-foot logs is— | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 1½ | 2 | 2½ | 3 | 3½ | 4 |
| | *Bd.-ft.* | *Bd.-ft.* | *Bd.-ft.* | *Bd.-ft.* | *Bd.-ft.* | *Bd.-ft.* | *Bd.-ft.* |
| 8 | 25 | ------- | ------- | ------- | ------- | ------- | ------- |
| 10 | 35 | 50 | 60 | ------- | ------- | ------- | ------- |
| 11 | 45 | 60 | 75 | 85 | ------- | ------- | ------- |
| 12 | 55 | 75 | 90 | 105 | 120 | ------- | ------- |
| 13 | 65 | 90 | 110 | 130 | 145 | ------- | ------- |
| 14 | 80 | 105 | 130 | 155 | 175 | 190 | 200 |
| 15 | 90 | 125 | 155 | 180 | 205 | 225 | 240 |
| 16 | 105 | 145 | 180 | 210 | 240 | 265 | 285 |
| 17 | 120 | 165 | 205 | 240 | 280 | 305 | 330 |
| 18 | 135 | 185 | 235 | 275 | 315 | 345 | 375 |

[1] From *Tables for Estimating Board Foot Volume of Timber*, by Clement Mesavage and James W. Girard. U. S. Dept. Agr., Forest Service, Unnumbered Pub. 94 pp. 1946. The International ¼-inch log rule gives volumes that closely approximate lumber tally at many Southern mills.

TABLE 4.—*Average number of slash pine trees per cord,*[1] *by diameter and total height*

| Diameter breast high (inches) | Trees per cord when total height of tree in feet is— | | | | | | |
|---|---|---|---|---|---|---|---|
| | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| | *No.* | *No.* | *No.* | *No.* | *No.* | *No.* | *No.* |
| 6 | 40 | 28 | 21 | 16 | 13 | ------- | ------- |
| 7 | 31 | 21 | 16 | 12 | 10 | 8 | ------- |
| 8 | 24 | 17 | 13 | 10 | 8 | 7 | ------- |
| 9 | ------- | 14 | 10 | 8 | 6 | 5 | 5 |
| 10 | ------- | 11 | 8 | 6 | 5 | 4 | 4 |
| 11 | ------- | 9 | 7 | 5 | 4 | 4 | 3 |
| 12 | ------- | 8 | 6 | 5 | 4 | 3 | 3 |

[1] Utilization to 4-inch top diameter outside bark.

## NAVAL STORES

Slash pine can be grown solely for gum production or for wood production, but the greatest income results when it is grown for both purposes. Forest-land owners should first consider the major wood products they wish to harvest, and then determine whether there is an opportunity for extra income from naval stores.

The best way to produce both gum and wood in the same stand is to turpentine only the trees to be removed in the next thinning or harvest cutting. Bark chipping with acid treatment is the best method for producing gum, and if removable gutters and nails are used on the face, the butt log can be sold at full stumpage value (fig. 14). At least 25 trees per acre 10 inches in diameter or larger are needed to support a profitable operation.

If it is possible to plan 10 years in advance which trees to harvest, the trees may be worked 10 years—5 years on the front face and 5 years on the back face. If cuttings can be planned only 5 years or less in advance, only a front face should be worked. All of the faced trees should be harvested as soon as turpentining is finished, because bark beetles, turpentine borers, and fire can cause severe losses if worked-out trees are left standing.

In naval stores stands, a shelterwood stand of about 25 trees per acre should be left after the harvest cut. This makes possible a turpentining operation while seedlings are becoming established. Turpentining the shelterwood trees may also stimulate greater cone production and thus make possible an abundant crop of seedlings.

Although turpentining reduces the current annual growth about 25 percent, the profit from gum should exceed the value of this sacrificed growth. On a 10-inch tree, for example, the value of lost growth as sawtimber is less than 5 cents with sawtimber stumpage at $25 per M board-feet, International ¼-inch rule. A farmer who has a laborer to work his trees or naval stores under a sharecropping arrangement with a 50–50 split of the gross return from gum can make a profit of 10 to 15 cents per face. So the value of the lost growth is really negligible when compared with the profit obtainable from gum.

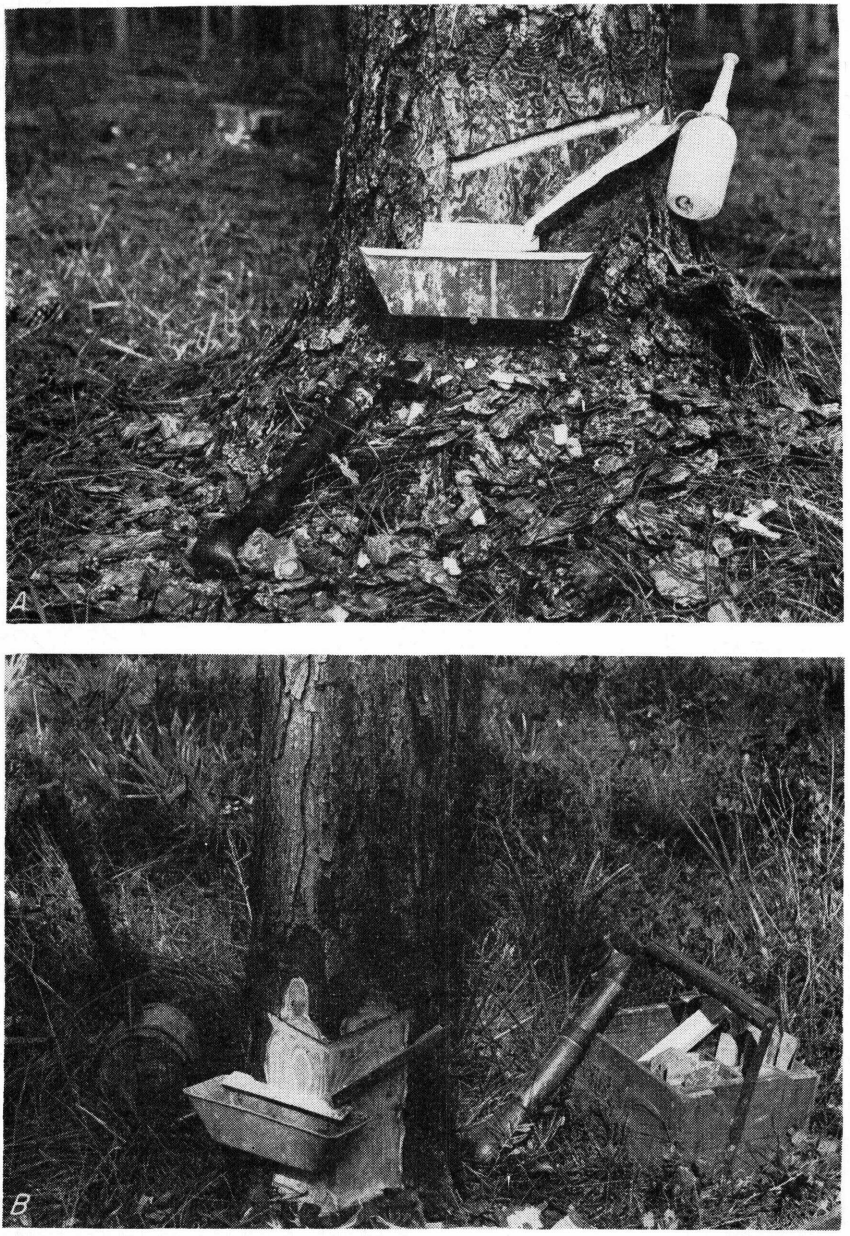


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**Figure 14.—*A*, This tree has been bark-chipped and acid-sprayed; it will give its owner the best possible return both in gum and in high-quality timber. Note that the spiral gutter and apron are attached with double-headed nails that can be easily removed when the face is worked out. B, Because the old method of turpentining shown here has marred the wood of the tree, a valuable part of the first log has been wasted.**

An attractive feature of naval stores is that the profit per face to a farmer is about the same whether he works only a few hundred faces or several thousand. The labor needed can be figured at the rate of 1 man full time year round for 5,000 faces. On smaller operations, a laborer could be used part time on naval stores and part time on other agricultural crops. Even a few hundred faces could be a profitable operation for the time required.

Some trees may be killed in naval stores operations, even by moderate turpentining. Such losses are most likely to occur during a drought when bark beetles may become active. Severe turpentining methods may also increase mortality. But ordinarily the loss in working trees will not exceed 1 percent annually.

Details of the best turpentining methods and the tools and equipment needed on a modern naval stores operation can be obtained from your State Forester, the State Extension Service, and the U. S. Forest Service.

## GRAZING AND TIMBER PRODUCTION

Coastal Plain forests have been a cheap source of forage for native cattle for many years. Unfortunately, burning for forage improvement has often been done at the expense of other forest values. Grazing, alone, does little damage to slash pine (fig. 15), and it can actually benefit timber production by reducing the buildup of fuel.

Most of the forage is provided by plants that tend to lack food value, especially during the late fall and winter. The food value of spring forage can be increased by burning the range in the winter,

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**Figure 15.—Cattle can graze in slash pine stands without harm to the timber, but they need many acres per head.**

but this treatment has little effect on forage quality after early summer.

The native wiregrass range can be grazed nearly yearlong if additional concentrated feeds are used during the fall and winter. Where ranges are burned during the winter, cattle should be kept off the burned parts from the time burning is done until the new herbage has made enough growth to support them. Otherwise, they will gather on the burned parts and severely damage the range.

The number of cattle that can be grazed on native range with best results depends on the kind and amount of vegetation found there, whether it has been burned or protected from fire, and on the number and age of the trees. During spring and summer cattle spend most of their grazing time on "burns." Therefore, they should be limited to the number that the burned area will support without damage to it. At least 6 acres per cow is needed during this period. If the forage is at its best, at least 15 acres per cow is needed for the entire year. As many as 50 acres per head may be needed, however, where the herbage becomes thinner under increasingly dense and more mature stands of trees. Generally, additional feeds or improved pastures are necessary to a well-managed operation.

## FURTHER INFORMATION

The State Foresters, most of whom are located at the State capitals, and the State Extension Foresters of the various State Colleges of Agriculture can give you further information about slash pine, and so can your local farm forester and county agricultural agent. These agents are in close touch with the State Extension Forester and have for distribution various leaflets on the subject of growing trees as a crop. Requests may also be addressed to the Office of Information, United States Department of Agriculture, Washington 25, D. C.

The following publications contain much valuable information:

*Growth and Yield of Slash Pine Plantations in Florida*, by R. L. Barnes. Fla. Univ. School of Forestry Res. Rpt. 3, 23 pp., illus. 1955.

*Naval Stores Production*, by C. Dorsey Dwyer. Ga. Agr. Col., Agr. Ext. Serv. Bul. 593, 28 pp., illus. 1955.

*Management of Natural Slash Pine Stands in the Flatwoods of South Georgia and North Florida*, by R. D. McCulley. U. S. Dept. Agr. Cir. 845, 57 pp., illus. 1950. (Can be bought from Superintendent of Documents, Washington 25, D. C., for 20 cents a copy.)

*Grazing Longleaf-Slash Pine Forests*, by Weldon O. Shepherd, Byron L. Southwell, and J. W. Stevenson, U. S. Dept. Agr. Cir. 928, 31 pp., illus. 1953. (Can be bought from Superintendent of Documents, Washington 25, D. C., for 15 cents a copy.)

*Planting Southern Pines*, by Philip C. Wakeley. U. S. Dept. Agr., Agr. Monog. 18, 233 pp., illus. 1954. (This is available in most public libraries, or it can be bought from the Superintendent of Documents, Washington 25, D. C., for $2.75 per copy.)

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